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UCLA SPACE SCIENCE CENTER
INSTITUTE OF GEOPHYSICS AND PLANETARY PHYSICS
LOS ANGELES, CALIFORNIA 90024

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FEASIBILITY STUDIES OF COORDINATED RADIATION EXPERIMENTS FROM METEOROLOGICAL SATELLITES

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SEMI-ANNUAL REPORT

November 1, 1966 to April 30, 1967

The design and construction of a modified skylight polarimeter, briefly described in the status report for the period May 1, 1966 to October 31, 1966, have been completed in preparation for the meteorological flight program sponsored by NASA Goddard Space Flight Center using a Convair 990 aircraft. These flight programs will form part of the support studies envisaged for the polarization experiment proposed to be carried out from Apollo Space craft. Detailed specifications have been worked out for the purchase of a special Datalogger for digitizing the analog data pulses from the polarimeter and recording them on a magnetic tape recorder. The complete details of the instrument and its special advantages for use in airborne operations will be described in a forthcoming report under preparation.

The main objective of this experiment is to investigate the polarization and scattering characteristics of various land and water surfaces under varying atmospheric conditions in the visible part of the spectrum. This information is needed in inversion methods to be applied to similar measurements carried out eventually from satellites for the purpose of observing particle distributions in the atmosphere.

The polarimeter will scan along the flight path at four wavelengths (0.40, 0.46, 0.52 and 0.58 microns) with a spectral band pass of 0.01 microns each and a 3° field of view. The scan will be from nadir to 15° above the horizon with a scan rate of 15 seconds.

An additional sensor consisting of a narrow beam (0.4°) downward-looking phototransistor is also flown for the purpose of monitoring the fluctuation in the relative intensity of backscattered radiation. This is to monitor the uniformity of the target.

The desired areas of observation included (a) desert sand, (b) green vegetation (without tall trees), (c) snow fields, (d) ocean surface of varying roughness, (e) uniform cloud decks at about 20,000 feet below aircraft, (f) random surfaces. The surfaces selected are as flat as possible over an area of about 80 x 80 miles and the horizon conditions symmetric with respect to either end of each flight path.

Vertical profiles from 8,000 feet to 40,000 feet at about 5,000 feet intervals at two solar elevation angles of $25\text{-}30^{\circ}$ and $50\text{-}55^{\circ}$ were desired with passes in four different directions of 0°, 180°, 90° and 270° to the sun's azimuth.

Preparations for the meteorological flight with the Convair 990 aircraft began at Ames Research Center, Moffet Field, California on March 28, 1967. The data flights were carried out on May 5, 6, 9, 11, 29, 30 and 31 and continued on to June 2 and 3, 1967.

During the reporting period considerable time and effort was devoted to the evaluation and discussion of the various design approaches for the proposed satellite instrument. These design approaches were presented by the prospective industrial contractors interested in undertaking the hardware construction work. There are several problem areas in the design of the instrument which required careful study and investigation. These are the physical characteristics of

the critical components, dynamic range and accuracy required, scanning mechanism, etc. A detailed set of specifications have also been prepared for issuing the satellite polarimeter request for proposals to carry out phase C task as per the requirement of the NASA Manned Spacecraft Center, Houston.

A paper entitled "A Modified Skylight Polarimeter" has been submitted and accepted for publication in the Journal of Scientific Instruments, London. As part of the procedure for the solution of the skylight inversion problem, a program has been worked out by use of which the solar zenith distance and azimuth may be calculated from the time of observation with high speed computers. This program will considerably simplify the effort otherwise required to obtain those values.